c) REMARKS

The Claims are 1-110 with Claims 1, 10, 19, 26, 38, 50, 60, 68, 78, and 86 being independent. Claims 19, 50, 60, 68, 78, 86, and 110 are amended. Amendments in reissue cases are in accordance with 37 C.F.R. § 1.173 and are not changed by 68 Fed. Reg. 3 and 611. Support for these claim amendments can be found on substitute specification page 11, lines 1-7, page 12, line 9 to page 13 line 9. The unamended claims are 1-18, 20-49, 51-59, 61-67, 69-77, 79-85, and 87-109. No new matter is added and reconsideration is expressly requested.

In the Office Communication dated June 27, 2003, the Examiner stated that claims 1-18 and 26-49 are allowable.

In the Office Action dated May 28, 2003, the Examiner objected to claim 110, as being of improper dependent form. In accordance with the Examiner's suggestion, Applicant has amended Claim 110 to depend from Claim 109 rather than from Claim 108. Therefore, Applicant respectfully requests withdrawal of the objection of claim 110.

The Examiner also rejected claims 19-25 and 50-110 under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention.

Specifically, the Examiner contends that the phrase "whereby increased slot density providing a uniform high-density plasma is obtained" is indefinite, alleging that it is unclear how shortening of the wavelength of microwaves in the wave guide will allow an increased slot density. The Examiner further alleges that while it may be possible that the shortening of the wavelength will provide a high density plasma, it will not change the slot density because the slot density relates to the structure of the wave guide which is controlled during the manufacture of the apparatus.

During the interview on October 7, 2003, Applicant's attorney pointed out to the Examiner that the second dielectric material shortens the wavelength of microwaves in the wave guide, and this shortening of the wave length allows for a higher density of slots to be introduced in the waveguide. The Examiner indicated that this description of the invention was very useful in understanding what Applicant wishes to claim. The Examiner further indicated during the interview that if the claims are amended to clearly point out the relationship between the plurality of slots and the second dielectric, and if written support is found in the specification for the amendment, the rejection may be withdrawn.

Applicant asserts that the claims, as previously presented, are not indefinite. However, in order to facilitate allowance of the claims, Applicant has amended the claims to further clarify the subject matter which Applicant regards as the invention in accordance with the language which was discussed during the interview. As currently amended, the claims indicate that the annular wave guide includes a plurality of slots <u>having defined positions in the annular wave guide</u>. The claims also indicate that a second dielectric material is included in the wave guide which shortens the wavelength of microwaves in the wave guide. The claims further indicate that the defined positions of the slots depend on the <u>shortened wavelength of microwaves in the presence of the second dielectric</u>, thereby generating a uniform high density plasma. Specific written support for this amendment to the claims is found in the specification at page 12, line 13 to page 13, line 9. At page 12, line 9 to page 13, line 9, Applicant has disclosed that a second dielectric material is provided in the wave guide (page 12, lines 9-12). Further it is recited that the dielectric constant of the second dielectric material is such that the slots are positioned so as to amplify an inherent surface wave to generate a denser and more uniform plasma (page 12, lines 13-20). At page 12, lines 26 to page 13, line 4 it is also taught that the presence of the second dielectric material provides a shorter wavelength, thus providing

slots at shortened intervals (i.e. ½ or 1/4 of guide wavelength) to generate a uniform high density plasma (page 13, lines 10-19). Applicant believes the claims are thus sufficiently clear. Therefore, Applicant respectfully requests withdrawal of the rejection of the claims under 35 U.S.C. § 112, second paragraph.

The Examiner also rejected the claims under 35 U.S.C. § 103(a) as being allegedly unpatentable over Suzuki (JP 7-90591) in view of Inoue (JP 5-62796) and Watanabe et al. (JP 7-263186).

Specifically the Examiner contends that Suzuki

> shows the invention as claimed including a microwave plasma processing apparatus, in which a plasma process is performed, comprising: a plasma generation chamber 1101, separated from ambient air by a first dielectric material 1102; a processing chamber 1111 connected to said plasma generation chamber; means 1113 for supporting a substrate 1112 to be processed; microwave introduction means utilizing an endless annular wave guide 1103 provided outside the first dielectric material which is provided with plural slots 1107; means 1108 for introducing gas into the plasma generation chamber; means 1115 for introducing gas into the processing chamber; evacuation means 1116 (see figures 9Aand 9B).

The Examiner admits that Suzuki does not expressly disclose that the interior of the wave guide is filled with a second dielectric material which is the same as or different from the first dielectric material. The Examiner then alleges that Inoue and Watanabe et al. disclose microwave plasma processing apparatuses similar to Suzuki that fill the wave guide with a dielectric material to generate a uniform density plasma in the plasma generation chamber (Inoue) and to make the microwaves and cut off frequency small (Watanabe et al). The Examiner then concludes that the present invention would have been obvious to the skilled artisan at the time the invention was made based on the disclosures of Suzuki, Inoue and Watanabe et al. The Examiner also alleges that Watanabe et al. disclose that the first dielectric

material can be quartz and the second can be Teflon and compares this to claims 72 and 90 of the instant application.

The Examiner further alleges that Suzuki discloses a cylindrical shape wave guide, or a disk, polygon, etc, and further discloses a magnetic field generating means which may be further provided to higher the density of the plasma and compares this to claim 74. In addition, the Examiner contends that Suzuki discloses the claim limitations of claim 99-110 in Claim 3 and paragraph 22 of Suzuki. Applicant respectfully traverses the grounds of rejection.

As pointed out by Applicant's attorney during the interview, Claims 19-25 and 50-110 relate to the discovery that enhanced uniform high density plasma can be produced by employing a second dielectric material in the annular wave guide tube which shortens the wavelength of the microwaves. This, in turn, allows for a greater number of slots in the annular wave guide. It is this ability to increase the number of slots in the wave guide which permits enhanced uniform high density plasma. Therefore, the presence of a second dielectric material in the annular wave guide tube is a patentably distinct feature that results in an enhanced plasma. The Examiner indicated that if this relationship between the plurality of slots and the second dielectric was clearly set forth in the claims, the art rejections may be overcome. However the Examiner further indicated that she would reserve the right to reconsider the art of record and to conduct additional searching if deemed warranted.

As Applicant has pointed out in previous responses and during the interview, the combination of Suzuki, Inoue and Watanabe et al. does not provide a *prima facie* case of obviousness. Assuming, arguendo, there is motivation to combine the references, the combination fails to provide a second dielectric material in an annular wave guide tube having slots, whereby enhanced high density plasma is produced. Particularly, from the combination of the references, the skilled artisan would not understand that a second dielectric material should

be used in an annular wave guide tube having slots with defined positions to reduce the wavelength of microwaves wherein the defined positions of the slots are dependant upon on the shortened wavelength of microwaves in the presence of the second dielectric material, which, in turn, results in an enhanced uniform high density plasma. Suzuki merely is representative of the prior art and does not disclose the use of a second dielectric material in the annular wave guide tube, or anywhere in the microwave plasma processing apparatus, but merely teaches the use of slots in the annular wave guide tube to produce uniform plasma.

The Examiner contends that the use of a second dielectric material can be "adapted" from Inoue and Watanabe et al. However, there is no motivation whatsoever from any of the cited references to modify Suzuki to include a second dielectric material in such a manner. First, Inoue and Watanabe et al. do not teach the use of a second dielectric material in an annular wave guide having slots in order to produce enhanced high density plasma. Second, there is no suggestion in Inoue and Watanabe et al. that modifying Suzuki to include a second dielectric material would result in enhanced uniform high density plasma.

As noted, Suzuki merely teaches a quartz tube which forms the plasma generating chamber (first dielectric material) and an annular wave guide having slots to produce uniform plasma. Inoue merely teaches employing a dielectric (not a second dielectric) in a wave guide to achieve a uniform distribution of plasma. Nowhere in Inoue is there disclosed a second dielectric in an annular wave guide tube having slots, or that using a second dielectric anywhere can produce enhanced high density plasma. Watanabe et al. uses a dielectric material to reduce the size of the wave guide in order to produce a miniaturized apparatus (Watanabe, paragraph 6), not for irradiating microwaves through slots in an annular wave guide or for producing enhanced uniform high density plasma.

There is no teaching in Suzuki that a shorter guide wavelength would be desirable or could result in enhanced uniform high density plasma. Moreover, while Watanabe et al. may provide a teaching that a dielectric material in the wave guide produces microwaves with a shorter wavelength, Watanabe merely teaches that this allows for the use of a shorter wave guide to miniaturize the apparatus. As such, the teaching of Watanabe et al. is not sufficient to provide a motivation to modify Suzuki because there is no teaching anywhere in either of the references that a shorter wavelength in an annular wave guide tube with slots having defined positions or a <u>second</u> dielectric material in the annular wave guide, would be desirable or would result in enhanced uniform high density plasma. In fact, the combination would, at best, teach a miniaturized version of Suzuki, not the present invention. Furthermore, as noted above, Inoue does not provide the teaching to compensate for the deficiencies in Watanabe and Suzuki.

The skilled artisan looking to Suzuki, Inoue and Watanabe et al. would have no motivation to combine the references absent prohibited hindsight and would not find a motivation from the references themselves. The skilled artisan would not expect from the teachings of the cited references that including a second dielectric in an annular wave guide having slots with defined positions to shorten the wavelength of microwaves in the wave guide, wherein the defined positions of the slots depend on the shortened wavelength of the microwaves in the presence of the second dielectric, would result in enhanced plasma, because none of the references teach that shortening the wavelength of an annular wave guide having slots with defined positions would have such an effect. Moreover, the skilled artisan looking to Suzuki, Inoue and Watanabe et al. would conclude that the combination would, at best, merely result in a miniaturized apparatus and the production of the same uniform plasma already taught in the art. Since little benefit would be expected, a combination of the references would be

counterintuitive, particularly since none of the references teach a second dielectric material in an annular waveguide having slots to produce enhanced high density plasma. Therefore, the references can not make obvious the instant claims.

Moreover, the unexpected results of Applicant's invention discussed in the Rule 132 Declaration filed on November 21, 2002, i.e. enhanced, higher density plasma which is attributable to the second dielectric material and greater slot density, is further evidence of the nonobviousness of the invention. The Examiner argues that, "a showing of unexpected results has not been made in the above-mentioned rejection". The Examiner also argues that Inoue and Watanabe suggest beneficial results will be obtained by employing a dielectric in the wave guide. Therefore the Examiner argues the results are not "unexpected". Applicant disagrees.

MPEP § 716.02 specifically states that unexpected results are, in fact, indicative of unobviousness. Section 716.02(b) of the MPEP states that the presence of a property not possessed by the prior art is evidence of nonobviousness. In Applicant's Rule 132 Declaration, it was shown that the electric field of the standing wave of the annular waveguide tube filled with the second dielectric material and having a greater slot density is <u>170% stronger</u> and much more uniform than the standing wave produced from the annular waveguide tube lacking the second dielectric material and having a lesser slot density. Even if, arguendo, a minor increase in uniformity may have been deemed expected, greater strength of the standing wave would not have been expected, much less 170% greater strength. A difference in a significant property can render a claimed composition unobvious. *See In re Henderson* 146 USPQ 372 (CCPA 1965) . The above-noted differences in properties are not merely differences in "degree" but rather are differences in kind. There is nothing in the art cited by the Examiner which suggests what enhancement, if any, would be obtained by combining the references.

Clearly a 170% increase in electric field strength which results in enhanced plasma deposition and is unexpected.

In addition, Applicant's Rule 132 Declaration provided more probative evidence than a comparison with Suzuki. M.P.E.P. § 716.02(e) at page 700-243 expressly permits Applicant to compare the claimed invention with prior art that is more closely related to the invention than the prior art relied upon by the Examiner. *In re Holiday*, 199 USPQ 516 (CCPA 1978). The Rule 132 Declaration provided comparative results both in the absence and presence of a <u>second</u> dielectric material. Applicant asserts that the comparison was done with an reference that is even closer art than Suzuki, namely a microwave processing apparatus having a first dielectric material in the plasma generation chamber and no dielectric material in the waveguide tube versus a microwave processing apparatus having a first dielectric material in the plasma generation chamber and second dielectric material in the waveguide tube. The presence of the second dielectric in the waveguide tube resulted in a 170% increase in strength. A 170% increase in strength provides an enhanced rate of deposition for film production, i.e. a much denser plasma will result in an increased rate of deposition which means a thicker film in a shorter period of time, which is also indicative of nonobviousness. Therefore, Applicant respectfully requests withdrawal of the rejection of the claims under 35 U.S.C. § 103(a).

The Examiner has rejected claim 110 for statutory type double patenting under 35 U.S.C. § 101. The Examiner contends that claim 110 is allegedly a substantial duplicate of claim 108. Applicant has amended claim 110 to be dependent upon and further limiting claim 109, thus obviating the double patenting rejection. Therefore, Applicant respectfully requests withdrawal of the rejection of claim 110 under 35 U.S.C. § 101.

In view of the foregoing comments and amendments, favorable consideration and allowance of all pending claims is earnestly solicited.

Applicant's undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

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Amended claims with markings showing the changes:

Claims 19, 50, 60, 68, 78, 86, and 100 are amended as follows.

19. (Currently Amended) A microwave plasma processing apparatus comprising:

a plasma generation chamber provided with a first dielectric material;

a processing chamber connected to said plasma generation chamber;

means for supporting a substrate to be processed, provided in said processing chamber;

microwave introduction means utilizing an endless annular wave guide with a plurality of slots having defined positions in the endless annular wave guide for radiating microwaves therethrough provided outside of said first dielectric material;

means for introducing gas for said plasma generation chamber and said processing chamber; and

evacuation means for said plasma generation chamber and said processing chamber;

wherein an interior of said annular wave guide tube is filled with a second dielectric material which is the same as or different from said first dielectric material so that the wavelength of microwaves in said wave guide is shortened~~, whereby increased slot density providing a uniform high-density plasma is obtained~~ wherein the defined positions of the slots depend on the shortened wavelength of the microwaves in the presence of the second dielectric, thereby generating a uniform high density plasma.

50. (Currently Amended) A microwave plasma processing method wherein a

substrate is placed in a microwave plasma processing apparatus comprising a plasma generation chamber provided a first dielectric material; a processing chamber connected to the plasma generation chamber; means for supporting a substrate to be processed, to be placed in the processing chamber; microwave introduction means utilizing an endless annular wave guide provided with plural slots having defined positions in the endless annular wave guide for radiating microwaves therethrough provided outside of said first dielectric material; means for introducing gas for said plasma generation chamber and said processing chamber; and evacuation means for said plasma generation chamber and said processing chamber, wherein the interior of said annular wave guide tube is filled with a second dielectric material which is the same as or different from the first dielectric material, so that the wavelength of microwaves in said wave guide is shortened, ~~whereby increased slot density providing a uniform high-density plasma is obtained~~ wherein the defined positions of the slots depend on the shortened wavelength of the microwaves in the presence of the second dielectric, thereby effecting a plasma process.

60. (Currently amended) A microwave plasma processing apparatus comprising:

a plasma generation chamber provided with a first dielectric material;

means for supporting a substrate to be processed;

microwave introduction means utilizing an endless annular wave guide with a plurality of slots having defined positions in the endless annular wave guide for radiating microwaves therethrough provided outside of said first dielectric material;

means for introducing gas into said plasma generation chamber; and

evacuation means for said plasma generation chamber;

wherein an interior of said wave guide is filled with a second dielectric material which is the same as or different from said first dielectric material so that the wavelength of microwaves in said wave guide is shortened, ~~whereby increased slot density providing a uniform high-density plasma is obtained~~ wherein the defined positions of the slots depend on the shortened wavelength of the microwaves in the presence of the second dielectric, thereby generating a uniform high density plasma.

68. (Currently amended) A microwave plasma processing apparatus comprising:

a plasma generation chamber separated from ambient air by a first dielectric material;

a substrate support for a substrate to be processed, located inside the plasma generation chamber;

an endless annular wave guide with a plurality of slots having defined positions in the endless annular wave guide for radiating microwaves therethrough provided outside of said first dielectric material;

gas inputs situated to introduce gas into said plasma generation chamber;

an evacuation system situated to permit pressure reduction in said plasma generation chamber;

wherein an interior of said wave guide is filled with a second dielectric material which is the same as or different from said first dielectric material so that the wavelength of microwaves in said wave guide is shortened, ~~whereby increased slot density providing a uniform high-density plasma is obtained~~ wherein the defined positions of the slots depend on the shortened wavelength of the microwaves in the presence of the second dielectric, thereby generating a uniform high

density plasma.

78. (Currently amended) A microwave plasma processing method wherein a substrate is placed in a microwave plasma processing apparatus comprising a plasma generation chamber provided with a first dielectric material; means for supporting a substrate to be processed; microwave introduction means utilizing an endless annular wave guide provided outside of said plasma generation chamber and provided with plural slots having defined positions in the endless annular wave guide for irradiating microwaves therethrough; means for introducing gas for said plasma generation chamber; and evacuation means for said plasma generation chamber, wherein the interior of said wave guide is filled with a second dielectric material which is the same as or different from the first dielectric material, so that the wavelength of microwaves in said waveguide is shortened, ~~whereby increased slot density providing a uniform high-density plasma is obtained~~ wherein the defined positions of the slots depend on the shortened wavelength of the microwaves in the presence of the second dielectric, thereby effecting a plasma process.

86. (Currently amended) A microwave plasma processing method wherein a substrate is placed in a microwave plasma processing apparatus comprising a plasma generation chamber provided with a first dielectric material; a substrate support for the substrate to be processed; an endless annular wave guide provided outside of said plasma generation chamber and provided with plural slots having defined positions in the endless annular wave guide for irradiating microwaves therethrough; gas inputs to introduce gas into said plasma generation chamber; and an evacuation system situated to permit pressure reduction in said plasma

generation chamber, wherein the interior of said wave guide is filled with a second dielectric material which is the same as or different from the first dielectric material, so that the wavelength of microwaves in said wave guide is shortened, ~~whereby increased slot density providing a uniform high-density plasma is obtained~~ wherein the defined positions of the slots depend on the shortened wavelength of the microwaves in the presence of the second dielectric, thereby effecting a plasma process.

110. (Currently amended) A microwave plasma processing method according to claim ~~108~~ 109, wherein adjacent slots of said plurality of slots are at a spacing of one half or one quarter of a guide wavelength of microwaves in said annular waveguide.